Space Weather Technical Forecast

Issued on Tuesday, 12 March 2024 at 13:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Daily Chance of R1/R2, eventually reducing before UTC weekend.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity as recorded by GOES16 and 18 has been low. The peak of these flares was a C3.9 at 12/1135UTC from the largest and most complex group on the disc, AR3599. This sunspot group showed some development and spreading in its intermediate spots in the period, with penumbral area increasing. This was in addition to the maintained delta spot in its leader. There are seven other sunspots on the disc, all of which are comparatively magnetically simple.

There were no earth directed CMEs in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 by ACE were fairly steady at between background and slightly elevated (380-400km/s). The phi angle was mostly positive (towards the sun) and the solar wind density was initially around average, but fell to below average throughout the period. The IMF was stable and small-scale, at or below 6nT through the period, with a north-south component ranging between +5 and -4nT with an erratic character.

The net result of the above solar wind measures was provisionally Quiet (Kp 0-2)

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux remained at background throughout.

High energy electron flux (greater than 2MeV) observed at GOES16 was mostly at Moderate levels, with a brief period of high flux between 11/1340UTC-11/1730UTC, with a peak of 1420pfu at 11/1605UTC. The observed 24-hour fluence showed a rising trend, with the 24-hour integrated fluence value at 12/0001UTC being 4.98e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a daily Chance of M-class flares from AR3599. This sunspot is expected to remain on the Earth-facing side until the end of the current UTC working week, whereupon the risk of Moderate activity should fall.

Solar Wind / Geomagnetic Activity: A CME associated with the M7.4 flare from 10 March may pass Earth as a glancing blow later in the UTC day of Wednesday 13th of March or perhaps during the 14th of March, giving a peak risk of a Slight Chance of G1 for the period as a whole.

Coronal hole fast wind activity is likely to be modest in the period, with an unnumbered coronal hole in the northwest perhaps connection through the 12th of March with a Chance of CH09/+ connecting during the 13th March, however this is the wrong polarity for the time of year and hence should have limited effects.

All considered, activity should mostly be quiet to unsettled with a Chance of Active intervals during the first three days, perhaps culminating in a Slight Chance of G1 should the 10 March M7.4 CME materialise.

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Energetic Particles / Solar Radiation: GOES18 high energy proton flux is expected to persist at background or close to background levels, with a very slight chance of S1 radiation storms, with the main risk from AR3599.

GOES16 high energy electron flux is likely to remain near its current diurnal Moderate to High oscillation in the near term, with electron counts perhaps reducing at GEO on the arrival of any 10 March CME 13-14th of March. There is a daily Slight Chance of Active fluence, probably peaking before midweek UTC prior to any CME influence.

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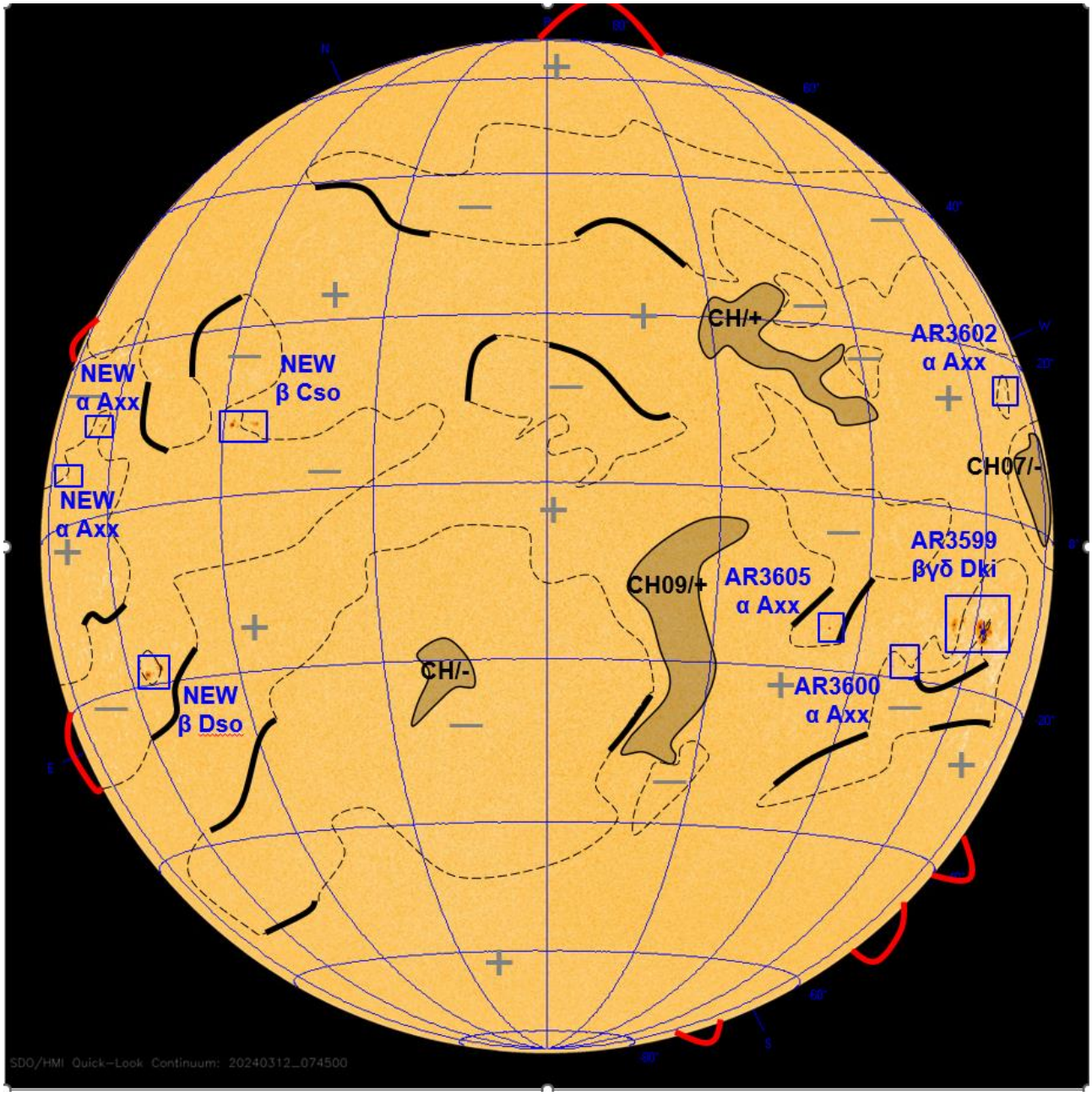
Figure 1. Solar Analysis Valid 12/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one CME in the forecast, a potential glancing blow from the M7.4 CME of 10 March, with this signalled to pass largely above and ahead of the track of the Earth in its orbit either late on the 13 Feb or early on the 14 Feb. MOSWOC Enlil and its ensemble suggest there is nevertheless a Slight Chance of glancing blow as it passes Earth, albeit with low confidence.

The fast wind aspect of the forecast is also of relatively low confidence, with none of the current cohort of coronal holes particularly well-formed or having strong links to previous incarnations on last rotation. An unnumbered positive coronal hole in the northwest may connect with earth through the 12th, with CH09 connection through the 13th February. As these holes are positive they do not lend themselves to strong connection given the time of year and hence should have limited effects.
Hence mostly quiet to unsettled conditions are expected the next few days, with a slight chance of active/Minor Geomagnetic Storm G1 Late on the 13th or through the 14th March should the 10 march M7.4 CME materialise.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
11/0145UTC	Partial	Following M7.4 from AR3599	NW quadrant	300 km/s	14/0000UTC	Glancing incidence lwo confidence

Figure 2: Latest MOSWOC Enlil run (badge time 12/0800UTC), paused at 1AU crossing time of M7.4-associated CME, which is expected to pass largely north and west of the Sun-Earth line. The

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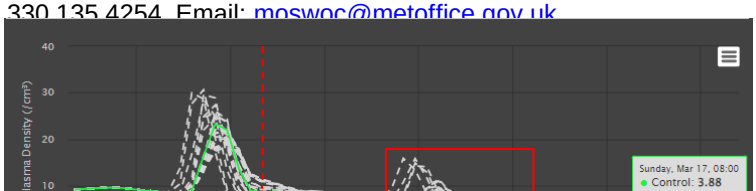
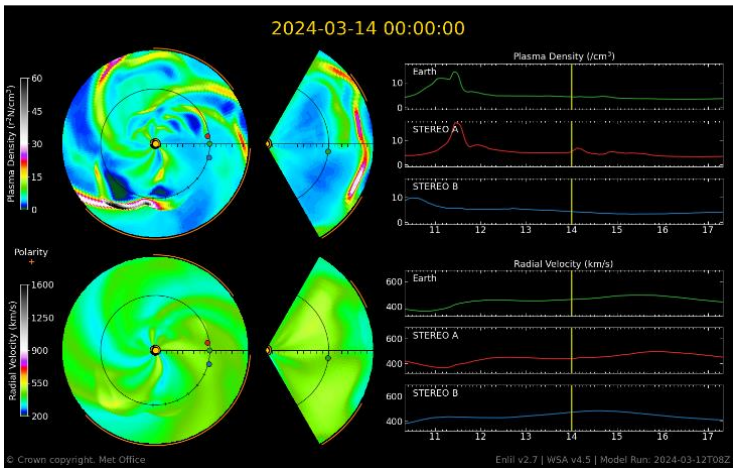


deterministic run is largely a miss, with a few ensemble members suggesting narrow glancing blows around 14/0000UTC.



Radio Blackouts - X-Ray Flares:

There are four numbered regions and four unnumbered regions on the visible disc. AR3599 remains by far the largest and most complex group, with merging penumbra in its leading spot- a delta region, now causing it to be classified as Dki/beta-gamma-delta. The remaining spots on the disc are relatively magnetically simple. Solar activity has been Low, but there is a daily chance of further M-class flares, with AR3599 being the most likely source. The main feature of the X-ray flare forecast in the coming four days is the eventual passing of this sunspot group on the far side, with this thought to occur on Friday 15 March and accompanied by a corresponding fall in flare risk on this UTC day. No significant returning regions are expected to slow or reverse this trend.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	20
Very Active	R3 to R5 X Class	No	5	5	5	1

Figure 3: Past 24 hours in GOES18 X-ray flux.

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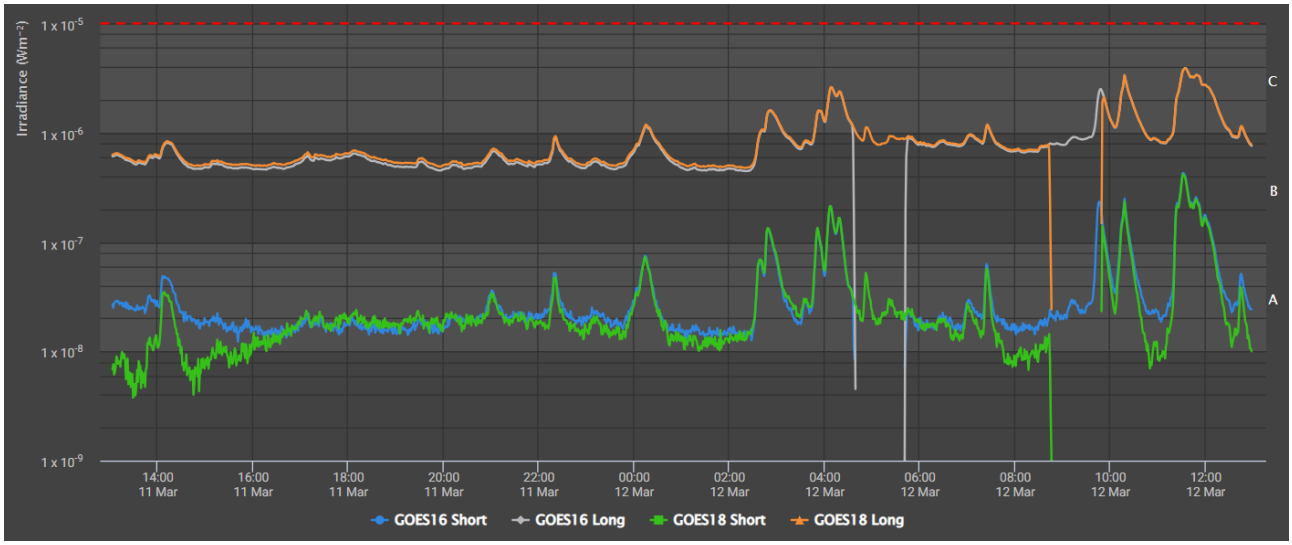

Solar Radiation Storms - (High Energy Protons):

GOES18 proton flux levels are very closely tied to developments in AR3599, with no other sunspot groups of note. This feature proved capable of a very slight enhancement at GOES18 on 10 March in the wake of the M7.4 flare. The risk of S1+ therefore increases very slightly through the period as AR3599 advances to the western limb and slightly beyond in the coming four days.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has shown a slight reaction to the recent CH07/-fast wind in flux levels rising from Normal Background to eventually exceed High on the afternoon of the 11th March. While it is still possible that this enhancement has yet to fully mature, in all likelihood current levels are probably near equilibrium and 24-hour integrated fluence may well fall a little short of Active. The probabilities of exceedance probably peak prior to midweek UTC and any CME influence from the 10 March M7.4, with a slight reduction possible to see out the working week.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	20	20	20	10
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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